A Teleconferencing System

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ABSTRACT

Training of health professionals commonly involves multiple sites in order to best utilize the available clinical material. However, this makes it difficult to achieve continuity in the presentation of didactic material. We have installed a teleconferencing system using high speed switching Asynchronous Transfer Mode (ATM) for transmission of audio, video and digital images. We aimed to emulate the ambience of a classroom at three sites in the training program. We are now in the first of a four phase evaluation trial with US West. Experience with implementing a new teleconferencing system using ATM switching is described.

INTRODUCTION

Use of computers in radiology has progressed from the initial uses in nuclear medicine to its incorporation in many digital imaging modalities.[1] Parallel developments in communications have resulted in the development of image transfer and the ability to use this modality for patient care, diagnostic imaging, training and education.[7][8] Educational uses of television are certainly not new but it is of interest that such uses are becoming more common in hospital settings.[2][3][4] Renewed emphasis on cost constraints has stimulated interest in applying new technologies in manners designed to reduce or make more cost-effective these expensive developments.[5][6][10] We are evaluating the educational feasibility of using a new teleconferencing system utilizing high speed switching.

The Department of Radiology residency program has 50 residents enrolled in a 4-year program. Like other academic units, our clinical assignments are located in more than one institution. Although based partly on historical reasons, this division is considered essential to the training of the resident because of the diversity of clinical experiences at each of three major hospitals. Each resident assignment is of 4 weeks duration resulting in 13 rotations per annum. The assignment by hospital is determined by a master curriculum and results in the following approximate distribution:

University Hospital. A 470 bed hospital with a focus on tertiary care located in the eastern portion of the metropolitan area, 2 miles from the U S West central office. Each resident spends approximately 48% of the time here.

Veterans Administration Medical Center. Located in the southern portion of the metro area 6 miles from University Hospital. Accounts for 30% of resident time.

Hennepin County Medical Center. 500 bed acute care facility located in the central metropolitan area, 2 miles from University Hospital. Accounts for 15% of resident time.

Because of the wide geographical distribution of the residents it is difficult to have a continuing series of programs or lectures to cover the didactic material associated with a formal program in radiology. Specifically, our faculty have expressed a strong desire to have the ability to present a connected series of lectures or presentations built around a central theme or core curriculum.

A distance learning environment for the University could be provided via the capabilities of a video conferencing system connected via Asynchronous Transfer Mode or ATM. ATM is designed to handle a highly variable mix of traffic, ranging from continuous bit rate applications like video and voice, to variable bit rate bursty applications like image transfer at speeds up to 155 Mbps. U S West proposed the creation of a distance learning trial that would allow the University to provide lectures and classroom environment over a two-way communication between the three hospital sites and at the same time allow U S West to experiment with the emerging ATM technology. The agreed cooperative proposal involves U S West, Fujitsu, AT&T and Siemens Stromberg-Carlson companies with U S West providing the coordination of the vendors and also providing the external linkages to the hospitals. (U S West is the regional telephone company in this area.) The trial will last 27 months, divided into four phases and will give each vendor the opportunity to individually support the environment and finally link them all together in a combined test of vendor interoperability.[9] The first phase of the trial is now beginning.

All equipment has been provided by and installed by the above named vendors and is on loan for the

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duration of the trial. Since this is a test of the feasibility of using high speed switching ATM mode and the costs of installation and provision of equipment have been borne by the vendors involved, we are not in a position to evaluate the costs or cost-effectiveness of this trial. We are interested in determining the clinical adaptability of using this modality in an educational setting.

DESIGN GOALS

We had two basic tenets in designing the system.

A. A speaker should be able to walk in and use the system unencumbered by technical details. The technology should be as transparent as possible.

B. The operational mode should duplicate the current 'modus operandi' as closely as possible. This means that it should be able to handle dual 35 mm. slide presentation, x-ray viewing from view boxes, chalkboard and opaque presentations. The speaker must be able to use a pointer to indicate areas of interest on the slides. Two-way video and audio complete the requested package. Remote viewers must be able to see the speaker and the speaker must be able to view the remote audience. Inherent in this is the preservation of a sense of spontaneity.

IMPLEMENTATION

At each site a conference room is supplied with microphones and remote controlled television cameras. A traditional overhead projector is replaced with a device containing a small analog TV camera. One camera is trained on the speaker. An infrared tracking device on the speakers microphone allows the speaker to roam at will and the camera will follow. This avoids the danger of a constant "talking head" image. The speaker can also easily direct the camera toward the whiteboard or adjacent radiographic viewboxes.

To preserve the quality and resolution of the material contained on the speaker's slides, either text or photographic reproductions of CT, MR or x-rays for example, it is necessary to digitize the images and transmit this data over a digital line rather than use the standard video. For this purpose an image acquisition system was created. An image presentation system is linked to dual high definition image display devices in each classroom replacing the usual dual projectors and screens. The traditional light pointer is not applicable in this arrangement and therefore an electronic system is used. By means of an infrared signal from a handheld "air mouse" an electronic cursor is moved across the two digital display systems. The "slides" can also be advanced with this unit.

The audio, video and digital display signals are then distributed to an ATM switch, centrally located in downtown Minneapolis, and then further distributed to the selected remote sites. The three hospitals and central office are connected by fiber optics. Diagrammatic representation of the system is presented in Figure 1.

CLINICAL USES

1. "Core curriculum". Throughout the academic year we give a number of lectures to the residents designed to cover the range of clinical radiology. We intend to organize this aspect of the program in a teleconference mode and make it available throughout the system.

2. Daily interesting case conference. Most training institutions have a daily interesting case conference. We intend to extend this throughout the system.

3. Visiting Professor. Each month a visiting professor spends a day in the department giving a number of lectures, conferences and then travels to one of our affiliated hospitals to repeat the presentations. The teleconferencing system will eliminate the need for excess travel.

4. Didactic course in physics of diagnostic radiology. A formal course in diagnostic physics has been traditional for residents preparing for board exams. We have already moved this course to the video format.

5. Coordinated medical student lectures. Students enrolled in an elective in radiology are located throughout our system. To date there has been no means to coordinate the didactic material presented to them. We foresee the teleconference as a solution.

CLINICAL ACCEPTANCE

A major concern in bringing in a new system is the acceptance of the system by the intended users. A survey was taken of the members of the department of radiology at all three sites before the system became operational. No special effort was expended in "selling" the system to the department nor was there any intention of providing a demonstration or orientation to the system before we were ready to become operational. We wished to sample opinion before any of the individuals had any firsthand experience. Members of the department became aware of the system as installation progressed. We made no effort to keep the project a secret but no demonstrations were carried out. It was generally accepted by the departmental members that a teleconferencing system was to be installed and they formed their own opinions as to its intended value based on their previous knowledge of such systems. Descriptions of such systems have appeared in the literature.[5] We intend to repeat the survey after the project has been in place for a minimum of 6

months.

A two-part survey was distributed to all members in the department. The first part was designed to sample concerns or fears about the use of the system. The second part asked for rating of the importance of several different features.

Results of the survey are displayed in Tables I, II. Opinion responses, Table I, are grouped by status of the responders: Residents, Staff Radiologists, Physicists and Graduate Students. Although no formal presentations of the system had taken place all responders but 3 have heard of the project. There is almost unanimous approval of the project with some concern expressed that it will take more time to prepare a presentation and be some hinderance to having a good conference. There is a strong feeling that imposition of an artificial electronic atmosphere will reduce spontaneity. Even though the capabilities of the imaging system were not demonstrated beforehand there was a strong acceptance of the ability to produce and transmit satisfactory text and graphic images.

There is mixed rating of the importance of the ability of speakers and students to see each other. (Table II) On the other hand, the importance of good audio and video communication is strongly indicated.

Not tabulated are the free form comments received. These mostly represented the desire to have a convenient means of providing uninterrupted "core curriculum" and the ability to present timely material to all residents throughout the system.

EXPERIENCE

Having recently begun use of the system our experience (as of March 30, 1993)) is somewhat limited. Some features do stand out however.
A didactic course in physics of diagnostic radiology has been offered for about 2 months via teleconference. The system lends itself well to this use. The copy stand TV camera has performed so well that there is little use for the traditional white board. Books, printed material and other visual material are easily shown in this mode. (It has also been possible to use this small copy stand for quick display of radiographs).

We have used the system to a limited degree in presenting lecture material. Initial acceptance is good.

Our limited use has turned up some areas of concern that are in the process of being corrected.
The audio system is critical in gaining acceptance to the system to users. We have had some problems in achieving complete problem free audio. Feedback and uneven sensitivity are some of the problems encountered. Corrective measures are now under way. Similar audio problems have been described in other teleconferencing systems.[5]

The remote pointer "air mouse" has been difficult to use accurately. Software modifications are in progress to make it more useable.

Table I
(Opinions and concerns)

Do you think the system will be useful?

	Yes	No	Don't know
Residents	11		1
Radiologists	17	1	
Physicists	2		
Grad Students	1		
	31	1	1

Do you think it will hinder the teaching conference?

	Yes	No	Don't know
Residents	1	5	3
Radiologists	4	14	1
Physicists		1	1
Grad Students		1	1
	5	21	6

Will it require more time for preparation?
Residents

	Yes	No	Don't know
Residents	5		6
Radiologists	16	1	2
Physicists	1	1	
Grad Students		2	
	22	4	8

Will it reduce spontaneity?

	Yes	No	Don't know
Residents	7	1	4
Radiologists	11	5	8
Physicists	2		
Grad Students	1	1	
	21	7	12

Do you think that the quality of text slides will be adequate?

	Yes	No	Don't know
Residents	9		3
Radiologists	14		5
Physicists	2		
Grad Students	1		1
	26		9

Do you think that the quality of radiologic images (x-ray, CT, MRI,US) will be adequate?

	Yes	No	Don't know
Residents	6		6
Radiologists	10	2	7
Physicists	1	1	
Grad Students	2		
	19	3	13

Will it be difficult to use/discourage you from using?

	Yes	No	Don't know
Residents	1	3	8
Radiologists	3	11	4
Physicists		2	
Grad Students		1	1
	4	17	13

Table II
(Desirable Features)

Least Important				Most Important
1	2	3	4	5
Ability of student to see speaker				
Res. 1	4	5	2	
Rad. 4	1	5	5	5
Physicists			1	2
Grad Students			1	1
5	5	10	9	8
Ability of speaker to see students				
Resident 3	6	1	2	
Radiol. 2	3	5	7	3
Physicists			2	1
Grad Students			1	
5	10	6	12	4
Two way audio				
Resident			5	7
Radiol. 1	1	2	2	14
Physicists			1	2
Grad Students		1		1
1	1	3	8	24
Ability to see 'ad hoc' visuals (x-ray, printed material)?				
Resident			2	10
Radiolo 1	1	1	2	15
Physicists				3
Grad Students				2
1	1	1	4	30

SUMMARY

An ATM teleconferencing system has been installed in a large department of radiology. Most of the users of the system anticipate that it will be useful in the training of residents but have some concerns thatsuch a system will have an inhibitory effect on the spontaneity of conferences. Initial experience is favorable. Some problems have been identified and are in the process of being corrected. A four phase evaluation trial is under way and will continue for approximately 27 months.

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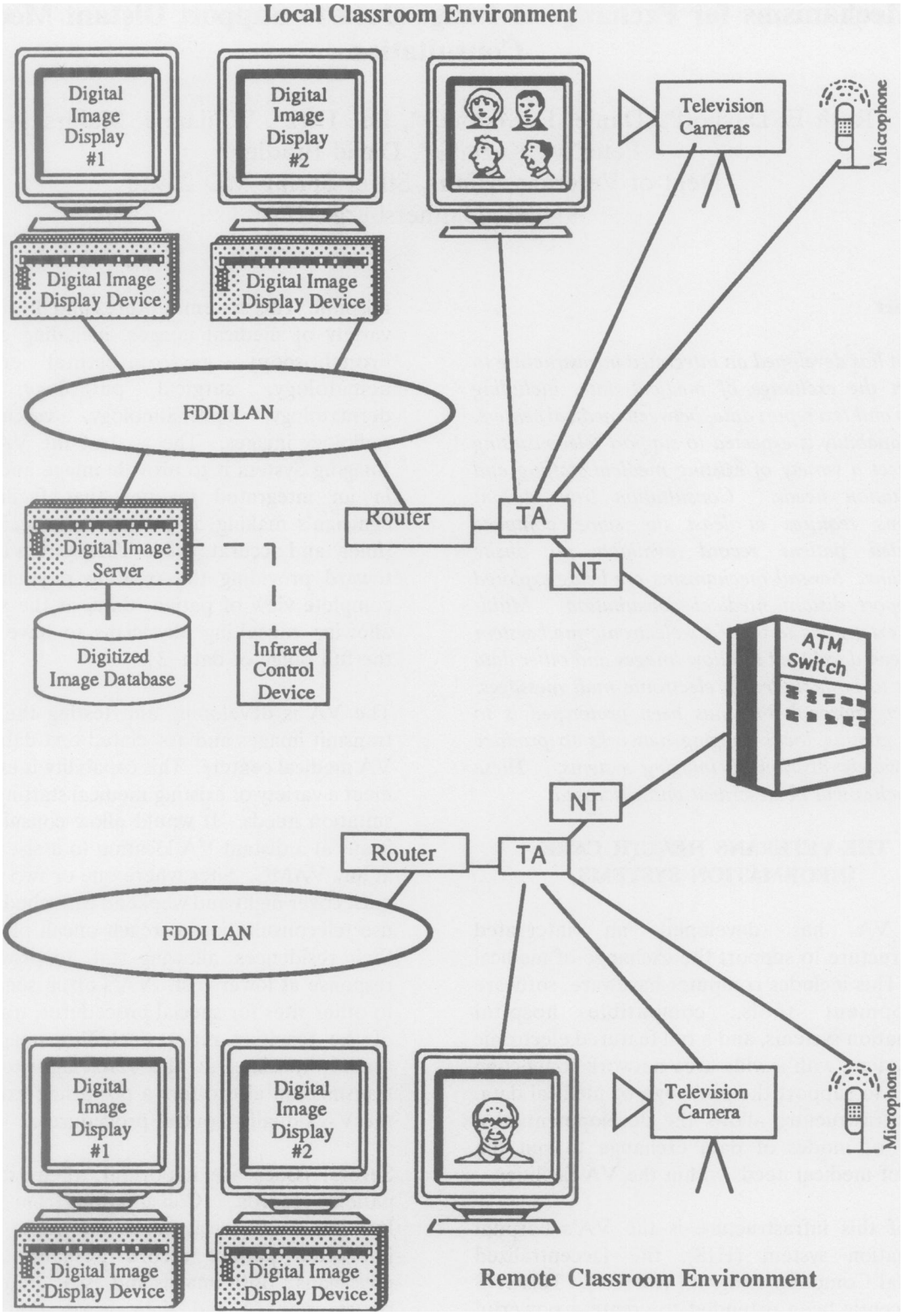

Figure 1. Schematic of local and remote classrooms. NT = Network Termination device. TA = Terminal Adapters. (From Foldvik and Walling [9]).